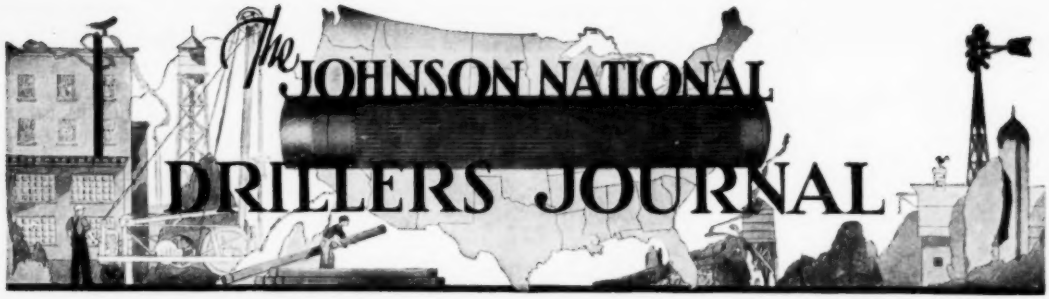

Vol. 23, No. 1 THE JOHNSON NATIONAL DRILLERS' JOURNAL Jan.-Feb., 1951

GROUND WATER RESOURCES AND THEIR CONSERVATION

GROUND WATER PROVINCES OF THE UNITED STATES (Continued)

F - North Central Drift - Paleozoic Province

This is one of the more important ground water provinces in the country, as it covers a vast area made up of the western two-thirds of New York, a small area in the northwestern part of Pennsylvania, the northerly two-thirds of Ohio, all of Indiana except a small portion in the southern part of the state bordering the Ohio River, all of Illinois except small areas in the northwest corner and Little Egypt in the southern tip, all of Iowa except small areas in the northwest and northeast corners, the northerly one-third of Missouri, the south-central part of the southern peninsula of Michigan, the southeastern corner of Nebraska and the adjoining area in the northeastern part of Kansas, and about one-third of Minnesota in the south-central part of the state.

Most ground water supplies in this area are obtained from wells in the glacial drift, glacial outwash deposits or beds of sand and gravel in the till formations. The water from the glacial drift in this area is generally hard but good otherwise. In many places flowing wells can be obtained from the drift. Wells drilled into the Paleozoic sandstones or limestones usually produce good supplies, though the deeper Paleozoic waters are generally highly mineralized and in many places are unfit for use. In many valleys flowing wells can be obtained from the Paleozoic water-bearing formations.

The preparedness program is now underway with its problems. Costs are rising and shortages in manpower and materials are developing.

Anyone in business knows this, but many people do not seem to realize that none of us can function as usual in these times.

Patience and consideration of the other fellow's problems are therefor essential to "carry on" under present conditions.

The glacial drift formations consist chiefly of till or boulder clay, alluvium, stratified beds of sand and gravel, loess and dune sand. The bulk of the formations is till which has a low porosity and does not yield water freely. The sand and gravel deposits made by glacial streams are the principal water-yielding materials in the glacial drift.

The rocks of the Paleozoic System lie beneath the glacial drift and extend over considerably more area. They are important sources of water wherever they are near enough to the surface that they can be reached by wells of ordinary depth. The conditions in New York near Tully in Onondaga County can be taken as representative or typical of the ground water conditions in the glacial drift area. Here there is a valley with high side walls and a rock bottom filled with a thick deposit of glacial gravel from which there extends a flat plain sloping to the south which is built of sands and gravels deposited by streams leading out from the ice margin. The southward sloping plain is characterized by its long shallow surface depressions which are surface lakes, some of them with no visible outlet. Sections in ravines and gravel pits facing northward show the material composing them to be sands, gravels, and clays. In the Watkins Glen area of New York similar conditions are repeated in the famous "Finger Lakes" region. Many of the wells, especially on the hill farms, are in rock, others are in glacial drift. Most of the shallow wells fluctuate with the season. Springs are common in these areas especially where outwash sands and gravels are present. In the past many wells were driven in the glacial deposits of Ithaca plain which flowed from depths of 80 to 100 feet. The sandstones and limestone formations of the Paleozoic system are used for deep wells and larger supplies inasmuch as they underlie all of that part of New York in Province F.

In Ohio the glacial deposits furnish by far the largest amount of potable water found in the state. These deposits cover nearly three-fourths of the state and the sands and gravels have been carried down the main valleys of the streams in the unglaciated portion

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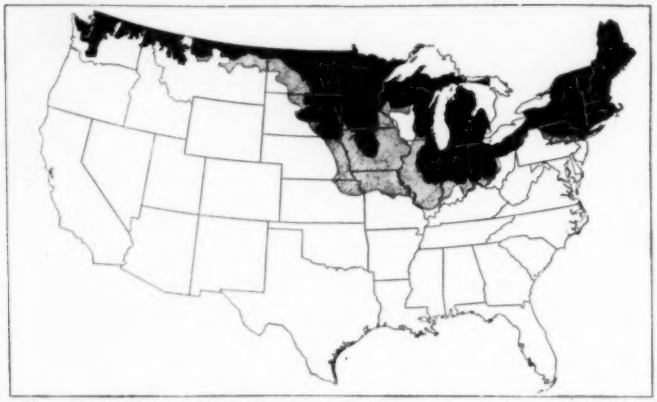

Map of the United States showing principal areas underlain by glacial drift. (After unpublished map by W. C. Alden.) Black indicates the Wisconsin or latest drift sheets; light shading indicates older drift. Outwash deposits and deposits of loess beyond the drift sheets are not shown. The glacial drift is the most important source of water supply in the northern part of the United States. (W.S.P. 489)

GROUND WATER PROVINCES OF THE UNITED STATES

(Continued from Page 1)

of the state furnishing large supplies of good water wherever found. The Illinoian drift sheet extends beyond the Wisconsin in a few counties in the central and southwestern part of the state. This drift sheet is composed largely of clayey material, except along the pre-glacial valleys, where deposits of sand and gravel can be found.

The Wisconsin drift is found in moraines composed mostly of sandy formations. On the plains between the moraines beds of sand and gravel are usually found between beds of till or clay. Wells in these formations are shallow as a rule and in places flowing wells are found. Much of the surface being drift is a clayey material furnishing a good cover or protection from surface pollution to the underlying water-bearing deposits. Flowing wells from the rock formations are rare though most of the beds are under artesian pressure. Flowing wells have been drilled at Orrville and Massillon. There are records of flowing wells obtained from surface formations in a belt that runs from southeast Michigan across northwestern Ohio into Indiana, also in deep pre-glacial channels in Allen, Auglaize and Mercer Counties.

As for the rock formations in Ohio, many permanent industrial and municipal supplies have been developed in them. The important water bearers are the limestones such as the Trenton, Clinton, Niagara, Onondaga and Corniferous, the Logan sandstone, the Berea grit, and some of the sandstone beds in the Coal Measures. The Onondaga limestone is probably the best of the limestone aquifers while the Trenton limestone, the deepest, is the poorest on account of its heavily charged waters being unusable. The Corniferous limestone is not too important on account of its relatively small area of outcrop, though at one time there were several flowing wells, from it at Columbus, and it supplied many springs along the Scioto valley. As a whole, the supply from the sandstones is limited and that from the Coal Measures is of poor quality.

Ohio ground waters are noted for their wide variance in chemical characteristics. Practically all shallow supplies carry dissolved carbonates of both calcium and magnesium. Iron is usually present, however, the waters from these supplies are generally used with little or no treatment. The water from deeper wells contains the same general ingredients with others such as chlorides, sulphates, and sulphides.

The ground water situation in that portion of Indiana in Province F is similar to Ohio, in that the glacial drift deposits extend to the Ohio River in the southeast part of the state, then runs northward to the northern part of Brown County, then westward into Monroe County, and then southwestward through Greene, Martin, Dubois, Pike, Gibson, and Posey counties to the mouth of the Wabash River. From Indianapolis south the glacial drift is thin but northward it is a heavy deposit averaging 200 feet in thickness. There are a few places in the southeastern part and small tracts in the southwestern where the drift is mostly clay but elsewhere in the state it is almost impossible to sink a well to rock without penetrating more or less water-bearing sand and gravel. The superior quality and quantity of water in the drift formations of Indiana make it one of the favored states as far as ground water supplies are concerned.

The water-bearing deep rock formations of Indiana are numerous and widely scattered. They are not all of them present at all places but utilized for whatever they will yield. The Niagara, Waterline, and Lower Helderberg limestones are the best producers while the Devonian and Waverly shales are the poorest. The Trenton limestone in Indiana is sometimes saturated with salt water or contains natural gas and oil. It is not a good water formation. The St. Peter sandstone can be found in the Indiana field, though it may contain salt water. As a general thing, the deeper rock formations of Indiana are not as prolific yielders of good water as the deep formations of Ohio.

All of the southern peninsula and the eastern half of the northern peninsula of Michigan are in Province F. Glacial drift covers all of the southern peninsula so deep that very few wells reach the underlying rocks. The rolling surface of the peninsula is broken by low morainal ridges left by the glaciers which once covered the region. The drift in places is 800 feet thick being underlain by a great oval basin of consolidated rock whose center is about 50 miles north of Lansing. The ground water situation varies, however, due to the fact that the drift contains much clay in places. For this

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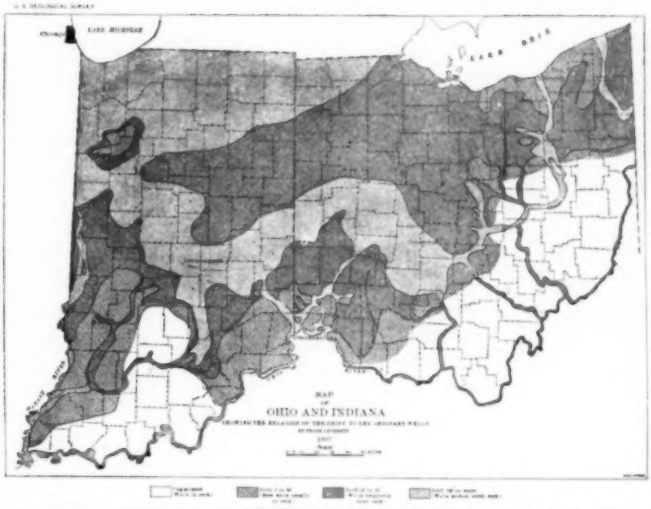
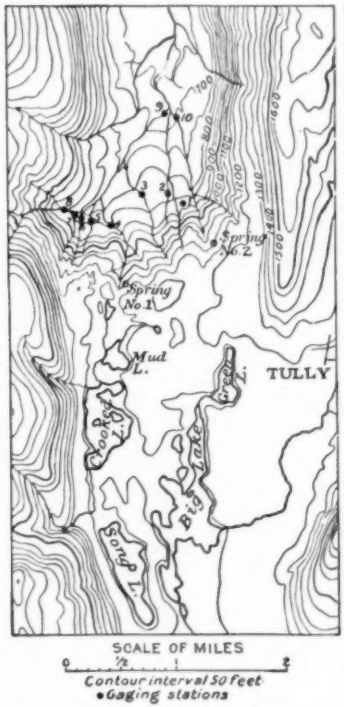
reason the peninsula has been divided into districts as follows:

Eastern shore district, an eastward sloping strip lying between the moraines and the shores of Lake Huron, St. Clair, and Erie, from Saginaw Bay to the southern limits of the state. The surface deposits are mostly clay. Small supplies are found in pockets of sand and gravel in the clay, but they are liable to fail in time of drought. Near the moraine better water-bearing sands are found and at one time Ypsilanti obtained its supply from the drift. The waters in the upper parts of the drift are of good quality, but those from the lower parts are often mineralized or charged with gas.

Saginaw Valley district. This district includes the drainage basin of the Saginaw Plain and adjacent areas. The surface is flat and the streams are shallow in valleys covered with clayey drift or hardpan from 80 to 100 feet thick. Good water can be obtained in this area from the underlying sandstones.





Sketch map of vicinity of Tully, New York. (W.S.P. 145).

Northeastern shore district. This district is the drainage area of the Thunder Bay River. To the southwest there is a high glacial moraine from which water can be obtained at considerable depth. It is hard water but good otherwise.

Western shore district. This district lies along the northwest and western coast of the peninsula and extends inward to the high morainal ridges. The surface is drift with the underlying rocks lying from 500 to 600 feet deep. The drift is generally clayey with many beds of sand mostly fine, however, good wells can be obtained if carried deep enough.

North-central district. This area includes the upper portions of the drainage basins of Manistee, Michigan, and AuSable rivers and adjacent areas. The surface is mainly sandy drift yielding water to shallow wells. Wells of larger capacity can be obtained by going deeper as the drift is from 300 to 500 feet thick in this area.

Saginaw moraine district. The region includes the Saginaw moraines in the central part of the state. The drift here is from 100 to 500 feet thick of variable composition but with many good water-bearing beds of sand and gravel. The underlying rock is also water-bearing and furnishes dependable supplies of water.

South-central district. This area includes all of the central portion of the state lying south of the Saginaw district. The drift is generally thick over the area with many horizons of water-bearing sand and gravel. The principal water supplies are obtained from wells in the drift of fairly shallow depth.

The rock basin underlying the drift also contains some good water-bearing formations, though some of them are not usable on account of the mineral salts, oil, gas or brine they contain. The Trenton limestone is the deepest but it yields brine. The Hudson and Utica shales are next higher but not good producers of water. The Dundee limestone carries considerable salt water and other minerals. Next above is the Traverse series which are alternate strata of limestone and shales 500 feet thick in places. The waters are valuable as mineral water.

The Autrim shales underlying the Berea grit yield neither fresh nor salt water in any amount. The Berea shale underlies the Coldwater shale but neither formation is important and as a source of fresh water. The Upper and Lower Marshall sandstones lying above the shale contain fresh water which can be developed from wells properly cased to hold out the water

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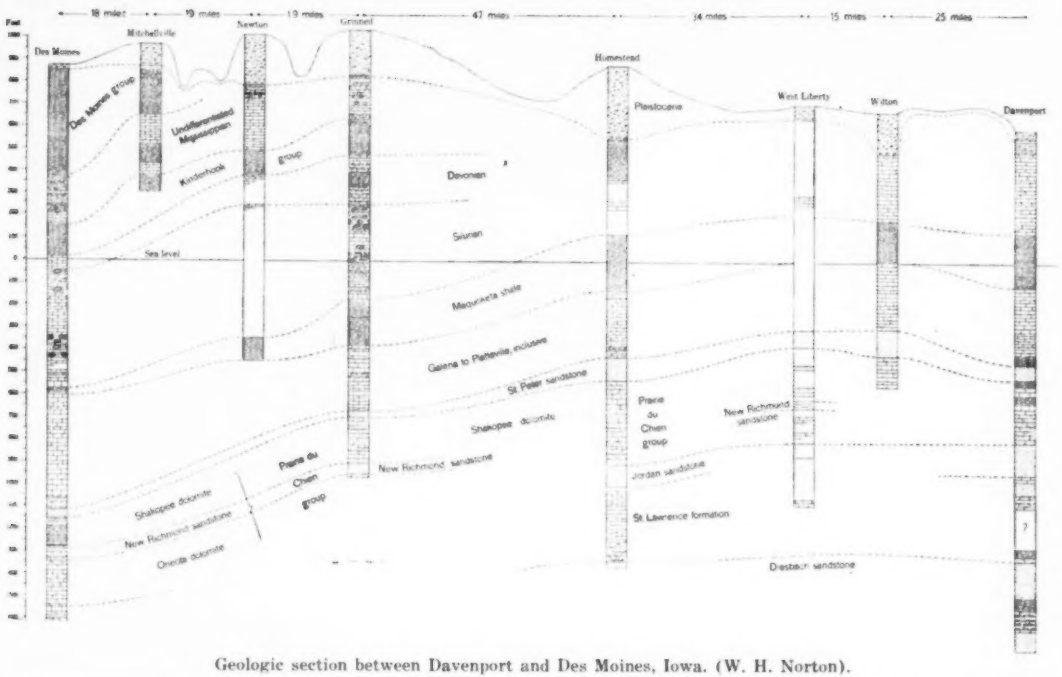

Geologic section between Davenport and Des Moines, Iowa. (W. H. Norton).

GROUND WATER PROVINCES OF THE UNITED STATES

(Continued from Page 3)

from the Michigan series of shales, limestones, and gypsum beds which is bitter and salty. The Grand Rapids limestone is a part of the Michigan series. The Parma sandstone lies above the Michigan series and contains hard water but pure. Overlying the Parma is a series of shales, sandstones, coal, fine clays, some iron ore, etc., which yield mineral water frequently of medicinal value. All in all the lower peninsula of Michigan is fortunate to have an unlimited supply of usable ground water.

The portion of Wisconsin lying in Province F is that part of a region described as the Wisconsin District which covers all of Wisconsin, the northern peninsula of Michigan, and all of Illinois north of the coal fields which is covered with drift deposits. The thickness of these deposits vary from a few feet up to 200 feet or more. In places there are pre-glacial valleys in the underlying rock which are filled with drift deposits of 200 to 300 feet in thickness. Near the shores of Lake Michigan, Lake Superior, and Green Bay, there are deposits of lacustrine material left by glacial lakes and rivers. These deposits vary from silt and fine sand to coarse sand and gravel covered with beds of clay. These lake clays extend for some distance up the Green Bay and Fox River basins and are important as the overlying beds of clay confine the water in the sand-gravel formations below this making it possible to obtain artesian flows in many places from wells 100 to 200 feet deep.

Lying below the drift are the rocks of the Paleozoic era. Starting at the top these formations are the Waubakee beds of shaly limestone which are not important as water producers. Then comes the Niagara limestone lying in a broad belt in the eastern part of the state along the shore of Lake Michigan. In places these beds are granular resembling sandstone. The sandy beds and the porous places in the limestone afford good water supplies, some of them flowing. Next lower are the Clinton beds of iron ore and the Cincinnati (Maquoketa) shale which are not important as water producers. Below these formations are Galena, Platteville (Trenton) limestones which often contain water-bearing sandstone. In limited areas in eastern Wisconsin these sandstone layers are important sources of water. The St. Peter sandstone lying next below is probably one of the best known aquifers in this area. It is irregular in thickness varying 20 to 80 feet. Inasmuch as the St. Peter is underlain by the siliceous Lower Magnesian limestones the two formations are developed as one. The Lower Magnesian is a dolomitic limestone containing scattered beds of sandstone. The Madison is known as Jordan sandstone and corresponds to the Oneota, Shakopee dolomites of Iowa and Minnesota.

Below these formations are the St. Croixan or Potsdam sandstones the thickness of which varies greatly, as they are thin where they contact the older crystalline rocks and then increase in thick-

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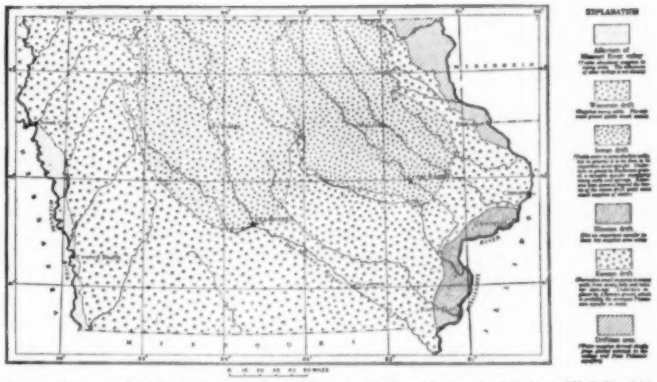
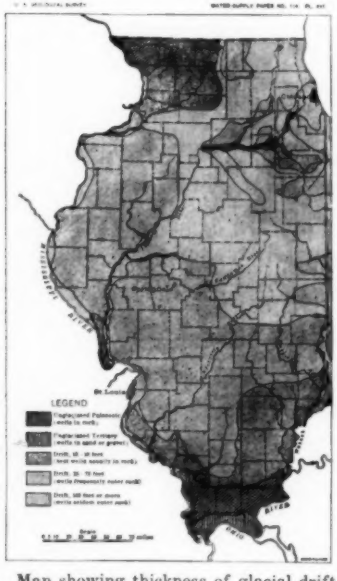
ness as they are removed from the crystalline area. In eastern Wisconsin Chamberlain estimated the thickness of this formation to be 700 to 800 feet. The Potsdam sandstone varies from a soft coarse grained sandstone to a firmly cemented sandstone suitable for building purposes. As a whole, it is an important source of water supplies. The lowest water-bearing formation above the igneous bed rocks are the rocks of the Keweenawan system which contain one sandstone formation. As a whole, the rocks of this system are not important though wells have been constructed in them. The ground water resources of Wisconsin are ample for all foreseeable purpose though they vary considerably in location and capacity.

The larger part of Iowa is in Province F and while the ground water conditions vary somewhat they are typical of the conditions in the northern part of Missouri, the southeastern part of Nebraska, and the northeastern part of Kansas. Even the south-central part of Minnesota can be included in this description. The surface of the area is practically all a gently rolling plain as left by the retreat of the glaciers. Only near the margins of the area are marked irregularities or at places where the glaciers were stationary for long periods in their retreat to the north. In Iowa at least five different invasions of the ice sheets are recognized each one of which deposited a corresponding sheet of drift. The first invasion was the Nebraskan followed by the Kansan, the Illinoian, the Iowan, and the Wisconsin. The Kansan is the oldest drift sheet appearing on the surface. It is exposed over an area equal to one-half of that of the state. It has been drained of practically all ground water by the streams in the region.



Map of Iowa showing glacial drift sheets. (After Samuel Calvin.) W.S.P. 489.



Map showing thickness of glacial drift in Illinois. (W.S.P. 114).

In the southeast corner of the state a small area of younger drift overlies the Kansan, extending along the Mississippi River from Princeton to Madison in a belt from 5 to 20 miles wide. This is known as the Illinoian though the surface is thickly covered with loess. The water table stands high in the loess except where it is drained by the larger river valleys.

The drift left by the Iowan covers the greater portion of the northeast quarter of Iowa. On the east it is separated from the driftless area in the northeast corner of the state by a narrow belt of Kansas drift. The country is a low, flat, poorly drained plain, with the water table standing high. It is the source of supply of many wells for municipal and industrial purposes. The youngest of all the drift sheets is the Wisconsin which lies in a broad lobe extending from the Minnesota-Iowa line to Des Moines. Its western line is near Sibley, Storm Lake and Panora and its eastern line near Clear Lake, Iowa Falls and State Center. It is well marked by terminal moraines. This is the lake region of Iowa. The absence of a loess cover on the surface leaves the drift exposed. Due to its high content of boulder clay, there is a limited amount of percolation. Wells in the low places usually find plenty of water but on the higher hills they must frequently go to the rock formations to get a supply. As a whole, the drift furnishes ample water for all farm, municipal and industrial purposes in the area.

As for the rock of Iowa, they are divided into four divisions each separated from the other by unconformities. The oldest are the rocks of the Algonkian system which outcrop in Province I in the northwest corner of Iowa as Sioux quartzite. However, these rocks are nearer the surface in southern Minnesota. The next youngest rocks are those of the Paleozoic era which are mostly limestone and sandstones a great thickness and covering a wide area. Above these are the Upper Cretaceous sandstones, shales and limestones covering much of the northwest and west-central parts of the state. The fourth division is the drift formations which are spread over all of the area that is in ground water Province F. Iowa is another state that is fortunate in having an ample ground water supply. Wells of

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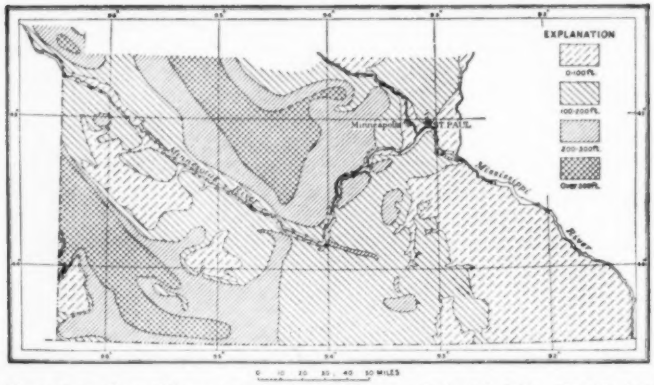

Map of southern Minnesota showing thickness of glacial drift. (W.S.P. 489)

GROUND WATER PROVINCES OF THE UNITED STATES

(Continued from Page 5)

all types are constructed in Iowa to take advantage of this supply. Many of the larger supplies are deep rock wells into the St. Peter, New Richmond, Jordan, Dresbach, and older sandstones. Above the Paleozoic rocks is the Dakota of Cretaceous time. Many of the deeper rock wells yield large quantities of water under considerable artesian head. The quality of the water is generally good, with the exception of the water from wells in the Carboniferous formation which varies widely. The Dakota sandstone everywhere yields large supplies, but they may be highly mineralized. In the unconsolidated formations above the rock there are many places where the people are prejudiced in favor of water from the "first, second or third bed." As a general thing, however, any water from the better known deposits such as the Afton gravel, the Buchanan gravel or veins found in the drift formations is usable.

The portion of southern Minnesota lying in Province F is composed of a thick succession of Paleozoic rocks covered in most places with the glaicial drift. Among the better water producing rocks are found St. Peter sandstone, Kasota sandstone, also the Jordan sandstone. In lower Dresbach formation the Mt. Simon sandstone is a good aquifer as is the Eau Claire found higher up in the formation. The Root Valley sandstone in the southeastern counties is also drawn on for water supplies in that area. The St. Peter sandstone which lies below Minneapolis and St. Paul is probably one of the best aquifers in the area. The formation extends over a broad area south of the Twin Cities. As a rule, the water from this formation is under artesian pressure. The Cedar Valley limestone outcrops near Austin while the Dakota sandstones are found higher up geologically. This formation when present yields well though the water may be and frequently is highly charged with minerals. The Minnesota Geological Survey has made a complete report on the ground water formations of southern Minnesota. They are described in detail in Bulletin 31 by Dr. George A. Thiel of the Survey.

In Nebraska only the southeast portion of the state is in Province F. The Pleistocene deposits have wide distribution in Nebraska as glacial and interglacial deposits in the part of the state east of the till border. Nebraska has many pre-glacial channels in the bedrock formations which were filled and refilled during glacial times. These deposits were eroded by glacial streams and in some places choked up with deposits which changed the courses of glacial streams. This resulted in heavy deposits of sand and gravel in places while in other locations the deposits were mostly fine sand, alluvial material poorly sorted. Thus there are several till sheets found in southeastern Nebraska which as a rule are underlain by sand and gravel beds of varying thickness. A study of the glacial deposits in Nebraska has been carried on for years by the Nebraska Geological Survey under Dr. George E. Condra, State Geologist, and is still being carried on to establish the origin of these deposits and their water-bearing possibilities.

The Tertiary system of rocks lie below the drift formations in the western part of the state but are missing under the portion in ground water Province F, as are the formations of the Cretaceous system, the uppermost bedrock being the Big Blue series of the Permian system of Paleozoic time. There follows in succession rocks of this system down to those of pre-Cambrian time. Very little is known of these rocks, particularly their water-bearing ability, as there has been little deep drilling for water wells in the section of Nebraska. No doubt this is due to the fact that better water can be obtained from the drift formations.

During Pleistocene time the northern half of Missouri, which is in ground water Province F, was covered with drift which in places is 300 feet thick. The ice sheets

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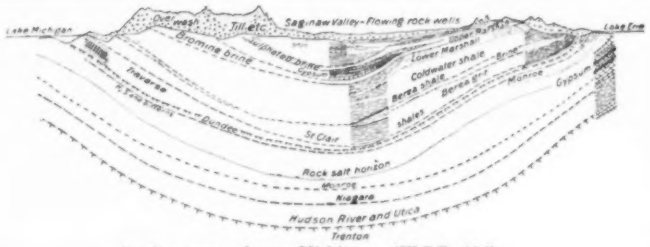

Section across lower Michigan. (W.S.P. 114).

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eroded large areas and filled up old channels in the underlying rocks. As a result there are deep valleys draining the surface formations. The wells in the north-central district covering that portion of Missouri lying north and northwest of the Santa Fe railroad obtain water from the Des Moines sandstone of Paleozoic time. The water is often salty and is found under sufficient artesian head to flow in places.

The south-central district includes the area lying south of the Santa Fe railroad and a line running from Kansas City through Sedalia, Versailles and along the Osage and Missouri Rivers to Warren County and then north to Iowa. As a rule the drift formations in this area are thin and the driller must look for water in the underlying rock formations either Des Moines or the Mississippi limestone. In the northeastern part of the state the Keokuk limestone is found but is not an important water-bearing formation. The most important water-bearing formation is probably the St. Peter sandstone though it may be thin in places north of the Missouri River. The geology of Missouri and its water-bearing formations have been studied closely by the Missouri Geological Survey at Rolla. Drillers in Missouri will profit by consulting this state agency on all deep drilling as the ground water conditions vary greatly from one place to another.

As we have said, Province F is one of the most important of the ground water provinces, as it covers a large area and supplies most of the ground water used in the area. All known types of wells and methods of construction are used to make these developments possible.

"Where are you going, Mac?" asked Jim.

"Oh, I heard about a swanky new tavern down the street," replied Mac. "I thought I'd go down and look it over."

"In that case why are you carrying that Bible?"

"Well, if it's as good as I heard I plan to stay over Sunday," answered Mac.

Figure 1—10-inch Sparling saddle type meter for portable mounting.

PORTABLE METER USED IN TEXAS

A three-year study of irrigation practices and the factors affecting the cost of pumping and spreading water in the pump irrigated sections of the southern High Plains of Texas was undertaken in 1947 by the Bureau of Agricultural Economics and the Texas Agricultural Experiment Station.

In connection with this work, Mr. William F. Hughes, Agricultural Economist, U. S. Department of Agriculture, was faced with the problem of obtaining well yields accurately. He says "several factors combine to preclude the use of conventional measuring devices that consume so much time and man power, such as weirs, flumes, orifices or current meters. With 250 measurements to be obtained by one man within a period of three to five weeks each season, a fast, reliable, portable and easily installed measure device was essential. The Sparkling meter mounted for portable use was provided as an answer to the problem. Although the meter as mounted and used did not fulfill all of the needs precisely, the results obtained through its use were highly satisfactory.

"Measuring procedures developed through experience in the use of the portable mounted meter differed widely in many respects from those anticipated. Construction details of the pipe section in which the meter was mounted and measuring procedures evolving from three years of use are presented here with the thought that others might profit from this experience.

Construction

"The pipe section, with meter in place, along with most of its dimensions is shown in Figure 1. Design of the pipe section followed a suggestion advanced by Dean W. Bloodgood, Irrigation Engineer, Soil Conservation Service, U. S. Department of Agriculture. It is constructed of 15-gauge galvanized steel and has an inside diameter of 10 inches at 70° F.

"The discharge end of the pipe is elevated in a 90° turn with the lowest point 2 inches above the top of the main discharge pipe. This assures a full pipe of water in measuring, provided care is used in placing the pipe. As originally constructed, the discharge outlet

(Continued on Page 11)

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TOM'S COLUMN

Dear Fellows:

Well sir as I sit here lookin' out the window I'm watchin' a battlin' blizzard that makes the outdoors look like a wildeyed jamboree, an' it feels pretty good to be here inside. Sometimes I figger the whole durn world is mixed up in the same kind of a scramble as the outdoors looks like tonight. Just how all these countries got themselves all balled up in a logjam like this is confusin' to simple people like me—an' as far as I can see it aint very clear to the smart guys neither. After battin' around fer all these years, includin' a couple of hefty size wars, a depression, an' some lean stretches, I don't seem to remember ever meetin' up with a situation fouled up like this one. Maybe it's only the dizzy period that will finally level off into some kind of balance where we'll know what we can an' can't do.

Funny part of it is that there's jobs around, and people want the work done. The headaches come from tryin' to get hold of materials and equipment at the time an' in the place where the stuff is needed. There aint no doubt that this tightenin' up aint confined to drillers—it's the same all along the line, so drillers are pretty much in the same boat as other lines, as well as the people who supply them. Like all the others we gotta figger out as best we can ways an' means to meet these problems.

The boy an' me have been talkin' this over a good deal lately—an' last Sunday we sat in with a few of the drillers out our way fannin' the breeze about business prospects. We know that pipe is already hard to get in some sizes, an' there aint much chance of it gettin' better if it don't get worse. We know the freeze on materials they're talkin' about is gonna wind up in some kind of a priority system. The boy came up with a suggestion that may be worth something. He is gonna write to all our customers an' tell 'em that this is the time to have their wells checked an' repaired if anything is needed. He wants to tell 'em that the winter months is the slack time an' therefore the best time to get hold of labor, an' that such materials as may be needed is easier fer them to get now than maybe it will be later on. That sure is a fact, an' most of the well owners won't think of it if we don't bring it to their attention. A well that aint in the best of shape now sure aint gonna get any better later on, an' it's a cinch that materials will be scarce before they ever get plentiful.

When you do this fer the customer you're killin' two birds with one buck shot. In the first place it helps to keep the crew goin', an' in the second place it gives the driller a chance to do the customer a real favor in preparin' 'em for the future. Customers usually appreciate a driller's interest in tryin' to keep their water supply on a good keel. I guess I'll have to admit that in the old days I didn't do much of this, matter of fact

(Continued on Page 9)

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(Continued from Page 8)

years ago I didn't even keep a regular list of customers anywhere around. Thought it was a lotta bother an' figgered if a customer wanted anything he knew it better'n I did. Since the boy got to sluggin' into the business we changed all that. He gets off a letter to them once in a while and tries to give 'em information on some of the things affecting the wells or the water supply that they wouldn't be likely to know about. He looks on it as a business builder, an' every now an' then we find that it's worth doin'. In these lists we've made is a record of when the wells was put in—every driller knows how long well points and screens have been in use on certain jobs, so if you figger that time is runnin' out and they should be be checked or replaced, it's a good idea to let the customer know about it. These days when business firms are havin' plenty of aggravations tryin' to get material an' services—it seems kind of good to 'em fer to have somebody show an interest in their troubles.

Well, I s'pose a fellow could go on grousin' about all the troubles of the world an' get himself into a pretty sour state, but bein' as how this is the world we're livin' in the only thing to do is to make the best of it. There's still a lotta room fer some good natured fun, an' drillers don't let the troubles get 'em down. Fact is we oughta be used to troubles by this time. At the little session we had lately the boys got to tellin' stories an' tossin' a few beers, so life was quite merry. One of the lads was tellin' about how he built himself a pretty good reputation around his own bailiwick by callin' himself a specialist in aqua development. Sez he had it printed right on his business cards —an' while he admits there's a lotta things he don't know by golly the other guy figgers he must be all right because he claims to be a specialist. That led a solemn old driller known around here fer years as Swiftwater Gargler to tell us what a specialist is. A specialist he says is a fellow who knows very much about very little who keeps on learnin' more an' more about less an' less until he gets so he knows practically everything about almost nothing at all. One of the drillers was tellin' about how his car was swiped one night an' the police finally caught up with the thief so they jugged him. When the case came up in the police court the bird pleaded that he never meant to steal the car. He told the judge that the car was parked in front of what he thought was a cemetery so he naturally thought the owner was dead. He just felt sorry fer the abandoned car—an' wanted to give it a home.

Yep, we just took time out fer a while an' got a giggle out of things. Sometimes it aint easy to laugh off your troubles—but you aint no worse fer wear if you try it once in a while.

There aint much to gab about just now, so I better be lettin' you get back to your chores. Good luck to all of you.

Yours truly,

TOM.

Mr. Arthur Evans of Youngstown, Ohio has been drilling wells for forty-three years. He is now 71 years old, puts in 50 hours a week, and expects to drill wells for another 10 years at least. He says he wants to work out rather than rust out, which is certainly an admirable wish in these days of more pay and shorter hours.

Mr. Evans has been very successful over the years, owning a beautiful up-to-date home and equipment.

"Yes," said the old man, "I'll be 96 tomorrow, and I haven't an enemy in the world."

"A beautiful thought," answered the new vicar.

"Yes, sir," went on the old man, "I've outlived them all."

RAINFALL IMPORTANT

The U. S. government has been keeping rainfall records for many years and we can now depend upon these records at least to obtain our basic data regarding rainfall.

These records show that the annual precipitation is about 30 inches taking the country as a whole, and that this record is fairly constant year in and year out. Therefore, the water shortages that are being predicted from time to time are not based on shortages of rainfall, but on other factors which have nothing to do with rainfall.

These factors are: (a) a lack of storage on our streams, (b) draining of swamps and low areas, (c) excessive withdrawals of ground water above the annual rate of replenishment, (d) concentration of industries and population where water available is limited, and (e) waste of water above actual requirements. There are other minor factors entering the picture, but most of our water shortages can be charged to one or more of those mentioned.

It has been estimated that we use about 200 billion gallons of water per day for municipalities, industry, irrigation, and domestic purposes. About 30 billion gallons are from ground water and 170 billions are from surface water. One inch of rainfall is equivalent to 27,154 gallons of water per acre. If this is carried out to cover the country, our daily use of water is about the same as one inch of rainfall over the entire country annually. In other words, we are using only a small part of the 30 inches of rain that falls each year.

The trouble is that rain does not fall where we want it, when we want it. Our runoff or surface drainage is too fast resulting in floods, which carry water away before we can use it. Actually about 70 per cent of our precipitation is lost by evaporation and plant life use, 26 per cent is runoff which could by proper storage be used more than it is now. Only 2 per cent of the total is used by municipalities, irrigation, and industry. The balance is lost by waste or by using more water than is necessary.

(Continued on Page 15)

SURFACE and GROUND WATER CONDITIONS

December, 1950, was a month of extremes but dominated by excessive runoff; at key gaging stations it was the highest ever recorded in December and at 7 stations it was the lowest. Scattered floods occurred in the Northeast, Ohio Valley, and the Northwest, with maximum and near maximum flows in Maine, Virginia, Tennessee and Nevada. Ground water levels were also above average in northern New England and New York.

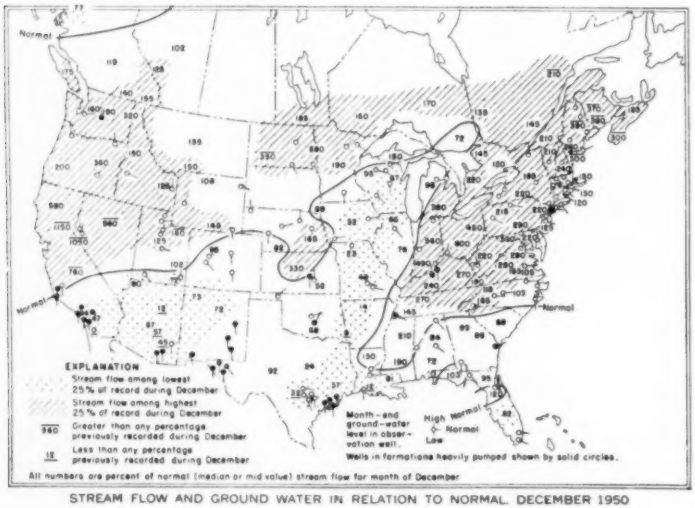
The drought in the Southwest remains critical. Storage reservoirs on the Gila River were exhausted and runoff in most streams was deficient with ground water levels in some areas at record lows for December.

In Virginia runoff was generally excessive and floods occurred in many streams draining the Blue Ridge in western North Carolina. Runoff was generally deficient in a narrow continuous band from Wisconsin to Texas, mostly as a result of low rainfall and cold weather in the northern part. In Kansas lower levels were observed in three key wells but were still higher than average. In Oklahoma ground water levels showed no pronounced trend but there was a net rise in the past year.

In Washington, Oregon, Idaho, Montana and Wyoming stream flows were at or near normal from various causes. Runoff was higher in Utah and in Nevada floods occurred in the Truckee, Carson and Walker River basins with ground water levels rising in many places. In California there were floods in the San Joaquin valley, however, drought conditions continued in southern California. In Arizona and New Mexico runoff as a whole was low; though there was a slight rise of ground water levels in December the levels were generally below those of a year ago.

In November, 1950, the water levels of many wells in Kansas declined but were still higher than a year ago. In Indiana ground water levels were rising, while in the north-central part of the southern peninsula of Michigan ground water levels were higher than a year ago.

In New York ground water levels were about normal on Long Island in November, 1950, in several wells the levels being at the highest level for the period of record. In central New England water in storage increased and at the end of November was well above normal. Ground water storage likewise improved but many areas were still slightly below normal at the end of the month.


Normal
EXPLANATION
Stream flow among lowest 25% of record during December
Stream flow among highest 25% of record during December
Greater than any percentage previously recorded during December
Less than any percentage previously recorded during December
Month- and ground-water level in observation well.
High
Normal
Low
Wells in formations heavily pumped shown by solid circles.
All numbers are percent of normal (median or mid value) stream flow for month of December

STREAM FLOW AND GROUND WATER IN RELATION TO NORMAL. DECEMBER 1950

THE MATERIAL SITUATION

A large number of letters are reaching us every day asking what may be expected in the way of materials—whether they are available now—what kind—and for how long.

Judging from the volume of correspondence on the subject, it is quite obvious that current information would be of interest to all. We will therefore give you such information as we have, together with our thoughts of what may transpire later on.

It goes without saying that the copper situation is rough and is one of the things that has been receiving considerable attention on the part of Washington. As you know, quite a number of articles have been ruled out and cannot be made after the end of February. Fortunately well screens are not on that list so far and it would appear that the various products connected with water supply will be okay to manufacture, at least for the time being. The ruling indicated that copper can be used, for example, for pipe lines if the water or liquid to be handled will attack steel or whatever alloy could be substituted. We think that leaves the door fairly wide open insofar as a number of products are concerned.

Now as to well screens. There is a definite amount of copper available each month for industry as a whole in the United States. That supply has been apportioned by the various copper producers among their customers by means of a quota system. We are, therefore, now being allotted a certain amount of material, based on the quantity which we used during the first six months of 1950. We are then permitted to receive 85% of this quota. At the present time, while it doesn't give us all the material we should have, nevertheless it does enable us to take care of our customers after a fashion. If the situation would stay that way, we would be quite happy. However, as Government orders start putting in their appearance at the various mills, these orders are placed ahead of civilian quotas and as the Government orders take more of the available copper supply each month, there will be less and less available to apply on the

(Continued on Page 11)

(Continued from Page 10)

quotas. Therefore, while we are now getting 85% of our quota, there is every indication that that quota will be cut from time to time, and goodness only knows where it will wind up. We are of the opinion that within another two or three months at the outside our quota will be cut more than 50%, which means that we certainly are not going to get enough material to get along on. Our only hope is that before things get too rough there will be some sort of set-up in Washington to which we can appeal, or that some arrangements can be made whereby certain priorities or what not can be passed along so that we can obtain material to make screens for you.

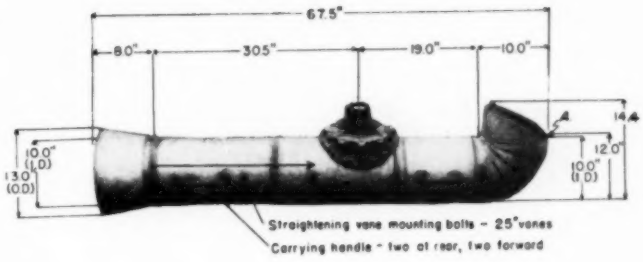
We have just been informed that Government orders are beginning to increase in volume and are taking more and more of the copper supply. If they continue increasing as they have the last couple of weeks, we believe that things will tighten up drastically in the very near future. That, of course, is something we cannot determine except as things develop from day to day.

At the present time we have material with which to fabricate screens in all metals. However, many customers are sending in firm orders for screens as soon as they are awarded a job so that we can set aside material for them when we get it. This, of course, ties up more and more of our future quotas.

During the last war, we were able to take care of our customers' requirements in a fairly reasonable fashion. There were difficulties, of course, and a lot of inconveniences, but the wheels kept moving. This was due primarily to the assistance you folks gave us. You gave us advance notice—as far ahead as possible—you frequently permitted substitution of materials, postponed jobs, etc. Your co-operation put the deal across.

If our guess is right, we will be faced with the same situation and while we will do everything humanly possible to keep the wheels going, it will again require your help, understanding and patience. If we keep one another informed and work together, the problem can be licked again.

W. M. Bollenbach, President.



A. Outside lip of discharge pipe 2" higher than top of body section. Difference in elevation obscured by photographic angle.

Figure 2—Portable mounted meter in use measuring 810 gallons a minute yield of well equipped with radiator cooled engine.

PORTABLE METER USED IN TEXAS

(Continued from Page 7)

was a full 4.4 inches above the main discharge pipe, but after a short period of use it was cut down to its present height and shape. Lowering the forward lip of the discharge outlet facilitates control of spent flow. Two steel straightening vanes 3.5 inches wide and 25 inches long are mounted horizontally in the forward part of the pipe section.

"The meter used is a 10-inch saddle type Sparling meter, with a normal operating range of 140 to 1,400 gallons a minute. The meter was calibrated at the factory and mounted within the limits prescribed by the manufacturer. It is calibrated to record in units of 100 gallons on the totalizer and can be read to 10 gallons on the unit hand.

"The complete unit shown in Figure 1 weighs 75 pounds and has an overall length of 67.5 inches. In order to hold the weight to a minimum the manufacturer provided an aluminum meter, saddle, cover plate and propeller. The total cost of the unit was $395.00, of which $340.80 was for the meter and $54.20 for the construction of the pipe section and mounting the meter.

Operation

"The unit shown in Figure 1 was attached to pump discharge pipes, field culverts and sluice box outlets by a heavy, water-proof canvas sleeve and the volume of water calculated from the number of seconds required to discharge a given quantity of water, (Figure 2). The most commonly used length of sleeve was 12 feet, however, for situations where this length did not permit satisfactory meter placement, sleeves 3 or 6 feet long were used. All sleeves had an inside diameter of 16 inches and were secured to the meter and to other outlets by short lengths of window sash cord.

"Avoiding the engine cooling system was the principal difficulty in using this measuring device. Most pumping plants included in this study were powered by auto motive type engines only a few of which were radiator cooled. The usual radiator substitute consisted of a closed circuit of 1½ or 2 inch pipe, placed in the sluice way in such a way and directly under the engine where the flow from the pump provides the necessary dissipation of heat from the engine.

"Highly sensitive and effective thermostatic controls, which shut off the ignition system when the engine temperature reaches a set point, were another hindrance. Engine temperature, particularly on V-8 engines, rises sharply when the flow of the pump is diverted from the cooling section. This necessitates fast action once the pump flow has been diverted and at times requires the measuring period to be shortened. Shortening of the measuring run has no significant effect on the discharge rates obtained.

"Cooling sections on most 'in line' engines seldom interfere with attaching the meter sleeve. Few, if any, difficulties are encountered in attaching the meter sleeve to

(Continued on Page 13)

Officers Empire State Well Drillers Association, 1951—Left to Right—Ray Knapp, President; Robert E. Klindt, Secretary; James Stoutenberg, Vice President; Fred Merrill, Past President.

ASSOCIATION NEWS

This section is devoted to the exclusive use of water well drillers' associations, both state and local. Notices, announcements, changes of officers and other items should be sent to The Editor, Johnson National Drillers' Journal, 2304 Long Ave., St. Paul, Minnesota.

MINNESOTA MEETING

Plans are being made for the annual meeting of the Minnesota Well Drillers Association, which will be held in Minneapolis, March 8, 9 and 10 at the Hotel Nicollet.

The program will cover a variety of subjects of interest to drillers with the annual business meeting and election of officers followed by the banquet on March 10 at 2:30 in the afternoon. Mr. Norm Ovram, Executive Secretary, is in charge of arrangements for the meeting and exhibit space. His address is 1495 W. Larpenteur Avenue, St. Paul 8, Minnesota.

OHIO MEETING

At a meeting held in Columbus, the Ohio Well Drillers Association, December 16, 1950, Mr. L. P. Cranz, Ira, Ohio, was elected President for 1951 with Mr. Eldon E. King, First Vice-President, Mr. V. J. Harley, Second Vice-President, and Mr. E. D. Allen of Steubenville, Executive Secretary and Treasurer.

The next regular meeting was held January 20 in the State Office Building with a talk by Mr. Walters of the F. E. Myers & Bros. Co. on pumping equipment.

WASHINGTON MEETING

The Washington State Association celebrated its fourth birthday with a two-day meeting at Seattle on November 10 and 11, 1950. In addition to entertainment for the drillers and their wives, some important business was taken care of during the sessions having to do with the future welfare of the Association. Mr. W. J. Walsh of Bucyrus-Erie gave a talk on "More Jobs and Bigger Profits." Mr. George Fish of the Spang Company and Union Iron Works gave a demonstration which was of interest to the drillers.

Regional meetings will be held March 17, 1951, at Moses Lake and July 21, 1951, at Walla Walla. The next annual meeting will be held November 9 and 10 at Tacoma. Mrs. Helen Davis, McCleary, Washington, is Secretary of the "Drillers' Doings."

OKLAHOMA MEETING

This association held its second annual meeting at the University of Oklahoma on November 24 and 25, 1950, with eighty-four drillers and others in attendance. A fine program had been prepared with Dr. Stuart Schoff of the U. S. Geological Survey and Mr. R. D. Alexander, Consulting Engineer of Oklahoma City, appearing on the program. Mr. L. L. Settle, Engineer of the State Department of Health, discussed the sanitary protection of rural water wells.

During the meeting Mr. R. D. Sawyer, Chickasha, was elected President, Mr. George Provine, Vice-President, and Mr. L. J. Clarke, Oklahoma City, Secretary.

MICHIGAN MEETING

The local groups of this association have held a number of meetings recently, among them being a new local No. 10 at Battle Creek which met with No. 2 at Kalamazoo on November 7. Mr. Floyd Wood is President and Mr. Edward G. Wood, Secretary of the new local. In the meantime, No. 6 at Port Huron and No. 8 at Lansing have held meetings and the Board of Directors met December 2, at Lansing, Michigan, to discuss insurance and other matters of interest to the association. Grand Rapids No. 9 met December 5 as guests of the Hayden Supply Company.

COLORADO MEETING

A meeting of this association was scheduled for Sunday, December 10, 1950, at the Shirley-Savoy Hotel in Denver to discuss: (1) the proposed code of ethics for the association; (2) amendments to the constitution; (3) extent of the state association participation in the national association; (4) incorporation of the state association. Mr. Rom Ahrens, 2034 Quitman Street, Denver 12, Colorado, is Secretary of this group and Mr. Archie Hier of Sedalia is President.

EMPIRE STATE MEETING

The annual meeting of this association was held January 10 at the Utica Hotel in Utica, New York. Election of officers and other important matters were taken up, followed by the annual dinner and award of door prizes which were won by Howard S. Bigelow of Schenectady and Louis Malanchuck, Croton Falls.

The new officers elected are:

President, Ray Knapp of Clarence; Vice-President, James Stoutenburg of Glenford; Secretary and Treasurer, Robert E. Klindt of Morris. Director of three years is Louis Malanchuck of Croton Falls.

During the meeting the group was advised of the death of Mr. Neil Crandall's father, an old-time driller, in New York state.

CALIFORNIA MEETING

A group of drillers in the north and central part of California have formed an organization known as Associated Drilling Contractors. This group held a meeting at the Hotel El Rancho in Sacramento, October 5 and 6, 1950, at which time Mr. J. F. Poland and G. H. Davis of the U. S. Geological Sur-

vey spoke describing the work of the Survey and the geology and wells in the valley area. Other speakers discussed well log reporting and electric logging of water wells.

Many drillers' wives were present at the meeting and enjoyed informal group meetings, luncheons and dancing.

NEBRASKA MEETING

Mr. V. H. Dreeszen, Secretary of the Nebraska Association, has notified us that the 1951 convention will be held February 22 and 23 at the University of Nebraska, Lincoln. Write Mr. Dreeszen at 105 Nebraska Hall, University of Nebraska, Lincoln 8, for further details.

ILLINOIS MEETING

The 24th annual meeting of the Illinois Association was held February 1, 2 and 3 at the Leland Hotel in Springfield. The program on February 1 was devoted to registration and examination of exhibits, followed by technical meetings February 2. The meeting closed with a discussion of specifications and engineer relations held Saturday morning, February 3. This was followed by the annual business meeting and election of officers.

The entertainment and banquet were held Friday evening, February 2, and added a very enjoyable feature to the meeting. Mr. Richard F. Fisher, Urbana, Illinois, as Executive Secretary, worked out the details.

INDIANA MEETING

The 1951 convention of the Indiana Association will be held in Indianapolis on April 24, 25 and 26. The indoor exhibits will be in the Athenaeum, located at New Jersey and Michigan Streets. All sessions of the meeting will be held in the same building, including the annual banquet. Outdoor exhibits will be displayed on an adjoining parking lot. Local No. 4 of Indianapolis is acting as hosts and expect to make this "the biggest and best yet." Mr. H. K. Carr, Greentown, is Secretary.

VIRGINIA MEETING

The Board of Directors has decided to hold the next annual meeting in Richmond, October 5 and 6, 1951. The present plans are for the meeting to be held at the Jefferson Hotel. Inquiries should be sent to the Secretary, P. O. Box 1568, Norfolk, Virginia.

WISCONSIN MEETING

Mr. R. H. Nienow, Merrill, Wisconsin, Secretary of the association, advises that the dates of the association's 1951 convention are April 19 and 20. The meeting will be held at the Hotel Northland, Green Bay. Mr. Nienow will furnish additional information on request.

PORTABLE METER USED IN TEXAS

(Continued from Page 11)

pumps powered by a radiator cooled engine or an electric motor. Discharge pipes usually extend into the open and the flexibility afforded by the 12-inch sleeve provides considerable leeway in placing the meter.

"A difference in head of 12 to 18 inches between the water surface in the sluice box and the lower lip of the discharge outlet is sufficient to handle all ordinary volumes of water.

"Regardless of the type of power unit or cooling system involved, a uniform measuring process has been followed. Generally, the pump is not stopped or flow reduced to attach the sleeve unless the volume is so great that it cannot be sleeved safely or the sluice way is obstructed by a cooling section difficult to sleeve through or around.

"The volume of flow that can be safely sleeved without stopping or slowing the pump depends on the conditions at each plant. Where conditions are favorable, the sleeve can be attached on flows up to 800 or 900 g.p.m. The operator in making the attachment must exercise caution that he is not drawn into the pump drive shaft or other moving parts by the weight of the water being handled.

"Once the sleeve is attached and flow started, the meter is turned upright (see Figure 2), and the flow allowed to stabilize before measuring the volume is started. This is usually a matter of 3 or 4 minutes. The whole measuring run can be made in 15 to 20 minutes.

"Although this device cannot be used on all wells, it has several features which make it advantageous, particularly when a large number of well yield measurements ments must be made in a short time."

DEEPLIFT EJECTO

The F. E. Myers & Bro. Company of Ashland, Ohio, has added a new pump to its line known as Myers "HN" Series EJECTOS which now gives them a complete line of ejector type pumps for well lifts up to 300 feet. The new units are furnished in 1½, 2 and 3 horsepower sizes. Some of the outstanding features of the new pump are: The flow of water is automatically divided in the separation chamber, so that the water supply pumped by the lower impellers to the ejector nozzle is maintained at the required pressure of from 80 to 150 pounds. The impeller above the separation chamber delivers water to the greater lifts and insures dependable service under all conditions, including the ability to handle air. This is ideal for crooked wells as there are no rods to handle or line shafts to wear. Offset can be made at any convenient location from the well, thus doing away with well pit. The units are compact, accessible and economical for lifts of 100 to 300 feet in wells 3 inches or more in diameter.

ADVERTISEMENTS

We will insert advertisements for drilling equipment wanted or for sale, help or work wanted, etc., for our readers, free of charge. Advertisements must be brief, and we cannot assume responsibility for them, but will be glad to put parties in touch with each other by this means and suggest that they investigate any offers or inquiries carefully for themselves.

FOR SALE: G.M.C. Army 4x6 tandem rear drive truck, 10 ton winch with steel bed, and shear poles for handling heavy equipment, equipped oil field style, excellent shape, cash $1,500.00; also #1 Steel Keystone, with cyl. Waukesha 45 motor and Cotta transmission, etc. cash $1,500.00; also slim hole portable rotary rig, on heavy duty White truck, etc. Complete photographs on request. For details, write: Gray Well Drilling Company, Post Office Box 181, Delafield, Wis.

FOR SALE: Three Clark Wichita Falls, Texas heavy duty spudders #55, #50 and #25 in good condition, mounted for quick moving. #55 is comparable in size of a 36-L Bucyrus-Erie, #50 is comparable to #28-L Bucyrus-Erie and #25 is comparable to #24-L Bucyrus-Erie. Also small spudder mounted on tractor truck. Write MCC, 2304 Long Ave., St. Paul 4, Minn.

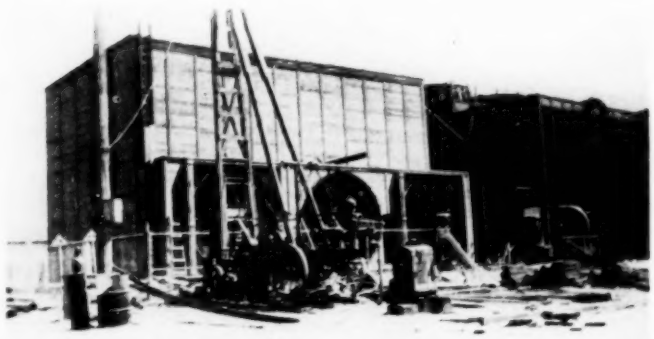
FOR SALE: One Fairbanks-Morse turbine pump with 200 ft. of 2½" pipe water lubricated; 3 horse power electric motor; used less than 90 days. Will sell for half price of new. Also for sale: One #42 Cyclone, 4 months old, cat heads, power derrick hoist, worm feed, tool guide, telescope derrick, 600 ft. drilling line, 600 ft. sand line and Continental engine truck mounted on '41 Chevrolet with 2 speed rear axle. Write: R. R. Long, R. R. #6, Jacksonville, Illinois; Phone 512.

FOR SALE: One Failing 314-C rotary rig, good condition, with 27 ft. mast; 4½"x5" mud pump, mounted on G.M.C 6x6 truck; price $7,500.00; water tank truck, drill pipe, casing, subs, slips, etc. available for the above drill at reasonable prices. Write: E. G. Wells, 716 East 5th Ave., Denver 3, Colorado.

WANTED TO BUY: An all steel rotary hydraulic drilling machine. Write: Charles K. Hedges, 5010 Bancroft Avenue, Lincoln, Nebraska.

Nine years experienced water well Indian driller, possessing both percussion and rotary exeprience, capable of dealing with officials and office works, wants steady job as driller or assistant in U.S.A. or any part of world on reasonable remuneration. Write: P. C. G. Mozumdar, 5 Panditia Place, Calcutta 29 India.

FOR SALE: No. 1½ Loomis Wire line machine with all steel telescoping mast; 32 feet high and power derrick hoist, mounted on '37 Dodge 1½-ton truck; machine powered with Willies jeep engine with electric starter and throwout clutch, less than one year old; complete set of tools; one cheap machine with mast 32 feet high mounted on '37 Dodge 1½-ton truck; one Hobart gas drive 300 amp. Arc welder. Write: J. W. Stephens, Christiansburg, Ohio.



B. M. Beers & Son drilling an 8-in. well 180 feet deep for the Montana-Dakota Utilities Company at Bismarck, North Dakota. The well produced 750 g.p.m. The cooling towers are shown in the background.

FOR SALE: Slim hole rotary drill rig, mounted on heavy White truck, a frame derrick and hoist, Wheatley, Mission, fitted pump 75 engine, double drum American Hoist with 50 H. P. engine table, hose, etc., complete with drill collars, 450 drill stem and Hughes rock bits, mud mixer, tongs, slips heavy army trailer for hauling stem, Kelley, etc., rig complete ready to go; photographs on request. This outfit cost $20,000.00 to assemble, best offer takes cash, f. o. b. Delafield, Wisconsin; also for sale, No. 1½ Steel Keystone drill, a frame steel derrick with hoist. Bucyrus rubber top, Waukesha 4 cylinder engine, V-belt drive with Cotta, transmission mounted on dual Titian truck with platforms for hauling rig and truck as is, no tools nor lines. Price cash $1,500.00; 6-inch tools and lines as is on machine, add $500.00 f. o. b. Delafield, Wisconsin. Write: Gray Well Drilling Company, Inc., P. O. Box 181, Delafield, Wisconsin.

FOR SALE: A 32-Star drilling rig on International Dual Wheel truck with tools to drill up to 7" holes and 4⅞" holes. Could dress bits to 8¼"; in good drilling shape; Also for sale 1-ton Pick-up International 1941 drilling rig, new derrick on it; also jars with tools. Write: George L. Harbison, Bakerstown, Pennsylvania.

FOR SALE: Bucyrus-Erie 21 W with 500 ft. cables; one year old; mounted on 1938 Chevrolet truck; also Franks Rotary 500 ft. machine complete with drill rods and bits; ready to go; mounted on 1941 Chevrolet truck; also Ferguson combination jetting and solid tool machine with drill rods and bits. Write: William Main, Thunder Hawk, South Dakota.

JOB WANTED: Experienced driller of four years in Massachusetts, Rhode Island and Maine, age 27; will go anywhere. Write: John Stafford, Center Lovell, Maine.

JOB WANTED: Experienced, sober, steady, hard rock driller wants year-round job. Excellent references. Write box CA c/o Edward E. Johnson, Inc., 2304 Long Ave., St. Paul 4, Minn.

FOR SALE: One Keystone Model 50 Spudder, telescope mast; pipe braces, stem guide, power hoist on derrick; machine used very little in A-1 shape. Mounted on 1½-ton International truck; price without tools or cables; $3,900.00. Write: Joseph Kopyar, Jr., R.F.D.4, 119 Trafford Road, Binghamton, New York.

FOR SALE: One 12-inch Worthington deep well turbine pump, 50' of 6" column with shafting, for 600 g.p.m. 125' head, with 25 h.p. vertical motor. Write: Monarch Marking System Company, Dayton 3, Ohio, attention of Mr. Richard C. Kelly, Purchasing Agent.

FOR SALE: All steel rig, semi-mounted on Model A truck; 32 ft. tower and 4 cylinder LeRoi motor; some tools; will sell for $1,100.00 or trade in on a larger rig. Write: Sydney Christenson, Route 1, Box 117, Cromwell, Minnesota.

FOR SALE: Well drilling machine, 1 year old, 20W Bucyrus-Erie, mounted on Dodge truck with tools. Write: Harry Champeau, 1231 Shawano Avenue, Green Bay, Wisconsin or Phone H-4158.

FOR SALE: One 21W Bucyrus-Erie drilling rig, trailer mounted, less tools, 2 years old with extra motor-rig used very little; one 20W Bucyrus-Erie, truck mounted, less tools, 1 year old and used very little; one 35 Cyclone used only on one job, complete with drill rods. Write: C. L. Jennings, New London, Iowa.

FOR SALE: One 71 Star all steel spudder equipped with International gasoline engine and drilling tools, from 10" down to 4" hole; including 1000 ft. ¾" drilling line and 600 feet sand line; all in good condition; approximately 350 ft. of 6¼" I.D. casing 17 pound and 150 feet 8⅝" 24 pound casing. A bargain at $2,500.00. Write: H. & E. Drilling Company, 3232 Piatt, Mattoon, Illinois.

FOR SALE: Sparta No. 10 drilling machine equipped with Allis Chalmers 4 cylinder motor; machine has trailer on rear end for semi-mounting on truck; this machine is in good running order; also a Sparta No. 30 machine, not in running order but can be bought very reasonably. Write: Chris Brunner, Sr., Stetsonville, Wis.

(Continued on Page 15)

(Continued from Page 14)

FOR SALE: Miscellaneous drilling tools and copper pipe; jars, bits, joints, drive clamps, bailers, etc. Write: Stirl F. Dysart, Route 4, Lincolnton, North Carolina.

FOR SALE: Complete drilling business consisting of three all steel drilling machines—two truck mounted and one unmounted; drilling tools from 5" to 15"; fishing tools, test pump and pump equipment; must be seen to be appreciated; will also sell all new resident buildings. Write: Box 278, Winnebago, Illinois.

WANTED: One 33-W Armstrong drilling machine. Write: C. F. Simpson & Son, 1000 S. Cedar Street, Nevada, Missouri.

WANTED TO BUY: Drill stem 14 to 18 feet long with 2x3x8 thread joint 3½ inch diameter or the complete string of tools with a stem of this size, or can also use a 4-inch stem 2x3x8 thread. Write: Adolph Rude, Flandreau, South Dakota.

FOR SALE: Approximately 300 feet of 16" O.D. by ⅜" wall pipe, just like new; torch cut ends; at $5.00 per foot. Write: Riegler Water Well Drilling, 2190 Henry Street, Muskegon, Michigan.

FOR SALE: One truck-mounted 1,000-ft. capacity ELI built rotary complete with water truck and all tools; A-1 condition throughout; sold with or without 1,400 feet new and used 4½" casing. Call 1450 Lewistown, Montana or write P. O. Box 37, Lewistown, Montana.

FOR SALE: Deep well pumps, used; one size 6SC, with 7½ h.p. motor, 75 g.p.m. 195' head; one size 8MC, with 20 h.p. motor, 200 g.p.m. 258' head; one size 8MC, with 25 h.p. motor, 300 g.p.m. 215' head; some parts needed to complete all of these pumps; subject to prior use and sale; no warranty whatever; available for inspection. Write: The Sherwin-Williams Company, Linseed Oil Mill, Cleveland, Ohio.

FOR SALE: One set of Peerless slightly used turbine pump bowls for 8" column 1,000 g.p.m. 90 ft. head, 12"; one set of Worthington unused turbine pump bowls for 10" size; one Peerless flat belt head 25 H.P. 1" shaft. Write: American Drilling Company, 907 River Road, Fair Haven, New Jersey.

FOR SALE: Failing double drum drill, Model 1000, complete, tools, drill pipe, etc., now operating near Belle Fourche, South Dakota; also Sullivan 1000. Write: Fred E. Butler, Box 1832, Casper, Wyoming.

FOR SALE: 21-W in first-class condition, ready to go with complete line of 5⅜" tools, new cables, gas welder, fishing tools; mounted on 1936 Chevrolet 1½-ton, with new motor and radiator; fine new tires; only $2,500.00. Write: Dee Linn, St. Joe, Arkansas.

BUSINESS COMES TO YOU: 5-room home on approximately two acres; established business; 2 rigs: B.E. 21-W and Star side arm spudder; 4" tools, other equipment and supplies; 1000 feet pipe; 14x24 storage building; located 4 miles east of city, East 10th St. Write: C. C. Brown, Route 11, Box 297-M, Indianapolis 44, Indiana.

Mr. Ralph E. Bower drills many irrigation wells in the central part of Nebraska. Here is a small reverse rotary rig that he built himself. The outfit weighs less than 4,000 pounds and is mounted on a trailer which he pulls with a truck. He can drill any size hole from 2-inch tubular wells up to 30-inch irrigation wells. It is not unusual for Mr. Bower to drill an 8-inch hole 150-feet deep in one working day.

Three old men were discussing the ideal way of dying. The first, aged 75, said he'd like to crash in a car going 80 m.p.h. The second, 85, said he'd take his finish in a 400 m.p.h. plane. "I've got a better idea," said the third, aged 95: "I'd like to be shot by a jealous husband."

This is a Failing rotary rig used by Fred E. Butler of Casper, Wyoming when drilling a 3,000-foot well in the vicinity of Rapid City, South Dakota.

NOTICE DRILLERS:

We need more pictures. Please send us snapshots or negatives of your rigs. We can use them and they will be returned if you wish. Don't put off sending them in. Do it today. Thanks.

EDWARD E. JOHNSON, INC.
2304 Long Avenue
St. Paul 4, Minnesota

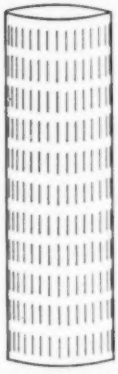
RAINFALL IMPORTANT

(Continued from Page 9)

So long as we have local developments, either industrial, municipal, agricultural, built up on short supplies of water, there will be shortages and critical areas to contend with. The ultimate solution is better and more storage of surface water and more scientific ground water developments, accompanied by better use of the water available. There is no forseeable shortage of water if water is conserved, developed, and used properly.

These Two Well Screens Are The Same Size—But—

JOHNSON SCREEN



PERFORATED SCREEN

the Johnson Screen has 3 times as much open area as the perforated type screen.

This fact is vitally important to the prospective purchaser of a well, *because it is only through open area that water can flow through the formation into the well.* All other conditions being equal, you have to buy 30 feet of perforated screen to equal the water transmitting ability of 10 feet of Johnson screen.

From a strictly dollars and cents standpoint, doesn't a Johnson Well Screen deserve a trial?

Based on the same size openings
JOHNSON WELDED WELL SCREENS
exceed all other well screens in strength
and capacity.

Edward E. Johnson, Inc.

Well Screen Manufacturers Since 1904

ST. PAUL 4, MINN.